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Monthly Progress Report for December 1961

EVALUATION OF REGENERATIVE FUEL CELL

Prepared for

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1. PROGRESS DURING MONTH OF DECEMBER

Charge retention and cycle life tests were continued. Polarization data was obtained as a function of temperature with the platinized nickel electrodes. Polarization data was also obtained for several new oxygen electrodes from a battery supplier. Some progress was made in the determination of the causes for voltage loss. Two final design changes were made on the multi-cell unit and the fabrication was initiated.

1.1 Charge Retention

The special 30 day charge retention test at room temperature was completed on January 2, 1962. The results showed that the cell retained and delivered 91 percent of the original input of 2.0 amp-hrs for the above stand time. The gas pressures during stand were near 85 psig and the open circuit voltage remained constant at 1.02 volts.

Another test with ambient temperature near 200°F and gas pressure near 200 psig revealed that the cell retained 90 percent of the original input after 72 hrs (as indicated by gas pressures).

1.2 Causes for Voltage Loss

A study of the effect of pressure differential on cell performance has established that this factor is definitely a cause for voltage loss. The study consisted of the application of pressure differentials (via the use of pressure regulators) while the cell was operating as a primary. The cell was first operated (at constant current) with equal H_2 and O_2 pressures. The voltage was continuously recorded at this condition and found to be constant near 0.94 volts. Next the H_2 pressure was increased in small increments until the point was reached where the voltage dropped suddenly to zero. When the O_2 pressure was made equal to H_2 pressure the voltage returned again to

0.94 volts. Finally the O_2 pressure was increased in small increments until the voltage fell to zero.

The results of these tests indicate that the cell voltage remains constant if the pressure differential is less than 10 psi (H_2 greater than O_2 or vice versa).

An investigation of the effect of electrode flooding on performance is currently in progress. Again the evaluation is being made by operating the cell as a primary. In this case the cell is to be discharged continuously at constant current until the voltage falls to zero. In this manner the maximum moisture content of the asbestos bed can be determined.

1.3 Polarization

The effect of temperature on polarization with platinized nickel electrodes for both H_2 and O_2 was measured at 50 psig. The results are tabulated below:

DISCHARGE CURRENT AT 0.7 VOLTS

Temp °F	Current Density ma/cm ²
88	12
150	25
180	44
230	102

Cell polarization tests were initiated with several new oxygen electrodes from a battery supplier. As per the recommendation of the supplier the polarization is being measured at both room temperature and 65°C (the optimum).

1.4 Cycle Life Tests

The 6 hr cycle life test described last month has been continued. The cell has now been carried through 22 complete cycles at 100 percent current efficiency. Each cycle consists of a 1 hr charge at 1.0 amps and a 5 hr discharge at 0.2 amp. One such cycle is carried out per day.

1.5 Multi-Cell Unit

Two changes have been made in the design of this unit and the fabrication was initiated on January 15, 1962.

The first change was in the dimension of the "O" ring groove so as to obtain a better gas seal. The second change was in the material of construction for the cell spacers. A high temperature grade of lucite was selected to replace the stainless steel for these spacers. The purpose of this change was to reduce the weight of the unit. (The weight is now estimated at 7.5 lbs and the output near 100 w.h.) The spacers are made conductive by a thin layer of nickel via the electroless nickel process.

2. PLANS FOR JANUARY

- a. Continue charge retention tests
- b. Continue cycle life testing
- c. Complete polarization studies with new O_2 electrodes from battery supplier
- d. Determine maximum moisture content of bed
- e. Finish fabrication of multi-cell unit
- f. Obtain performance data on multi-cell unit.